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2		Cog/Proj.Eng B.A. Kendall	[signature]	6-24-92	B4-66
2		Cog./Proj. Eng Mgr. R.L. Fritz	R.L. Fritz	6-24-92	R3-49
2		QA L.R. Hall	Larry R. Hall	6-24-92	B4-66
		Safety	[signature]	6-24-92	R3-08
2		D.L. Bjorklund	D.L. Bjorklund	6-24-92	S6-01

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Author/Requestor (Printed/Signature) Date
B. A. Kendall B.A. Kendall 8/18/92

Intended Audience
[] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature) Date
V. R. Dronen RL Fritz for 8/18/92

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Signature

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FUNCTIONAL DESIGN CRITERIA

MULTI-FUNCTION WASTE TANK FACILITY

PROJECT W-236

Prepared by

Westinghouse Hanford Company

June 1992

For the U.S. Department of Energy
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FUNCTIONAL DESIGN CRITERIA
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PROJECT W-236

Issued by:

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PREPARED BY:

B. A. Kendall 11/21/91
B. A. Kendall, Date
Project Engineer
Tank Farm Projects

WHC APPROVALS:

11/22/91
Manager, Date
Engineering and Projects
J.D. Thomson

11/22/91
Manager, Date
Quality Assurance
Organization J.A. Peltier

R. L. Fritz for V.R. Dronen 11/21/91
Level III Manager, Date
Projects Department
V.R. Dronen

11/21/91
Manager, Date
Defense Waste Remediation
Division J.H. Roecker

11/27/91
Manager, Date
Waste Tank Environmental
Safety, Health and Quality Assurance
P.R. Praetorius

11-27-91
Independent Nuclear Safety Date
M.N. Islam

S. Marchetti 12/3/91
Director Date
Tank Farm Project
S. Marchetti

11/21/91
Manager, Date
Waste Tank Safety Programs
J.L. Deichman

DEPARTMENT OF ENERGY APPROVAL:

17 Jan 92
U.S. Department of Energy Date
Richland Operations Office

TABLE OF CONTENTS

APPENDICES

ACRONYMS

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
CASS	Computer Automatic Survellience System
CFR	Code of Federal Regulations
DCG	Derived Concentration Guidelines
DCS	Distributed Control System
DOE	Department of Energy
EPA	Environmental Protection Agency
HEPA	High-Efficiency Particulate Air
HEME	High-Efficiency Moisture Eliminator
HEMF	High-Efficiency Metal Filters
HPS	Hanford Plant Standard
HVAC	Heating, Ventilation and Air Conditioning
HWS	Hanford Works Standards
HWVP	Hanford Waste Vitrification Plant
IEEE	Institute of Electrical and Electronic Engineers
LCCA	Life Cycle Cost Analysis
LCU	Local Control Units
MCC	Motor Control Center
MRP	Management Requirements and Procedures
MWTF	Multi-Function Waste Tank Facility
NACE	National Association of Corrosion Engineers
NEC	National Electrical Code
NFPA	National Fire Protection Association
OSR	Operations Safety Requirements
PCB	Polychlorinated Biphenyls
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RL	Department of Energy, Richland Field Office
SCADA	Supervisory Control and Data Acquisition
S/R	Storage/Retrieval
SDC	Standard Design Criteria
SS	Stainless Steel
UPS	Uninterruptable Power Supply
WHC	Westinghouse Hanford Company
VDT	Video Display Terminal

FUNCTIONAL DESIGN CRITERIA

MULTI-FUNCTION WASTE TANK FACILITY

PROJECT W-236

1.0 INTRODUCTION

This document provides the design criteria for a Multi-Function Waste Tank Facility (MWTF) and associated transfer facilities and systems. Current waste volume projections (Operational Waste Volume Projection, SD-WM-ER-029) indicate a need for an additional four million gallons of tank space on a priority basis. These tanks will provide safe, environmentally acceptable storage capacity, to handle wastes from single-shell and double-shell tank safety issues/mitigation and remediation activities. In addition to having space for resolution of safety issues, space is needed for related retrieval demonstrations, and to support the long-term cleanup mission at Hanford.

A portion of the facility will be utilized for staging and processing in support of pretreatment and the Hanford Waste Vitrification Plant (HWVP). The specific physical features and requirements have been incorporated.

The completion of this facility will also allow continued interm waste storage in a safe, environmentally sound manner which will be compliant with all appropriate U.S. Department of Energy Richland Field Office (RL), state, federal regulations and agreements, and the "Special Facilities" sections of the Department of Energy (DOE) Order 6430.1A (Division 13 and the -99 sections for Non-reactor Nuclear Facilities).

2.0 FUNCTIONAL CRITERIA

2.1 SITE LOCATION

The MWTF shall be located in accordance with the recommendations in the Site Evaluation Report (W236-SE-001 Rev. 1). The spoil pile location and borrow pit area, shall be stabilized after backfill by planting a suitable type of vegetation. The facility design shall incorporate grading and barriers as necessary to prevent possible flooding by man-made and natural causes. In the event this facility modifies existing required facilities, the project shall provide suitable replacement.

2.2 WASTE STORAGE AND CONFINEMENT

Each underground tank shall consist of two concentric structures. The outer structure shall be reinforced concrete designed to sustain all soil loadings, dead loads, live loads, seismic loads, and loads caused by temperature gradients between the radioactive wastes confined within the primary tank and the outside soil. The reinforced concrete tank shall be lined with a steel liner which extends along the bottom, sides and upper haunch of the concrete to the upper haunch of the primary tank. The concrete structure along with the liner shall provide the secondary confinement as defined by the Department of Energy (DOE) Order 6430.1A. The inner completely enclosed stainless steel tank shall be located within the secondary confinement and separated from the secondary liner by an annular space, and shall perform the function of the primary confinement as defined in DOE Order 6430.1A. A layer of insulating refractory shall be placed between the bottom of the primary tank and the secondary liner to protect the reinforced concrete floor from thermal stresses. The refractory layer shall be slotted to provide passages for annulus ventilation airflow. The primary tank shall be designed to confine the radioactive waste materials. The secondary liner shall safely confine any leakage that could occur due to a failure of the primary tank.

2.2.1 Primary Tank

Design criteria for the primary tanks are summarized in Table 1. The tanks shall be designed per the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III. Selection and application of the vessel code criteria shall be consistent with and in compliance with the vessel facility use category functional requirements. The tanks shall be designed to comply with all applicable Federal, State, and Hanford Site codes.

Provisions shall be made for inspection and monitoring corrosion damage to assess primary tank integrity during the design life of the tank, as specified in Section 3.4.3.

Provisions shall be made in the design for flushing, decontaminating, and cleaning of tanks, as required, to avoid mixing of different waste streams.

Provision shall be made in the design to enable pumpout of the HWVP/Pretreatment tanks to within 2% of the tank working volume (maximum tank heel) in order to maintain HWVP/Pretreatment Operations efficiency.

2.2.2 Secondary Confinement

The reinforced concrete structure shall support the bottom and walls of the secondary steel liner and support the primary tank and its contents. The reinforced concrete structure shall have provisions to transport any leakage from the bottom of the secondary liner to detection and collection facilities. During design, the effect of thermal transients on the reinforced concrete induced by the primary tank liquid level cycling shall be evaluated and documented to establish the maximum number of safe thermal transients that can be specified during the life of the tanks (operational limits). This evaluation shall assume the ventilation systems are operating at design capacity.

The secondary liner for the HWVP and pretreatment dedicated tanks shall be stainless steel (SS) and carbon steel for the other two tanks.

The secondary liner shall be designed to ASME, Boiler and Pressure Vessel Code, Section VIII, Division 2. An annular space between the primary tank and secondary liner shall be of sufficient width to allow penetrations from the top for inserting liquid level and leak detection devices; equipment for 100% visual inspection of primary tank exterior cylindrical wall; ventilation air supply and exhaust ductwork; and pumping equipment to remove leaked material from the annular space. The secondary liner shall be designed to confine the radioactive liquids in the event of a leak or failure of the primary tank until the liquids are removed to another tank. The secondary tank shall be designed to comply with all applicable Federal, State, and Hanford Site codes.

Provisions shall be made for inspection of the inner wall surface of the secondary liner for confinement integrity.

Criteria for the concrete structure and secondary liner are summarized in table 2.

2.3 TANK DOME PENETRATIONS

Primary tank dome penetrations shall be provided for all primary tank monitoring and processing activities. Monitoring systems are required for the primary tank liquid level, sludge level, temperature, and pressure measurements, corrosion probes, corrosion coupon access, sampling, and remote observation ports. Processing operations that require tank penetrations include the tank ventilation, waste retrieval, waste mixing, pretreatment, and drainage collection from various pits and encasements located on or near the tank. Construction access shall be provided for the primary tank.

Secondary liner penetrations through the tank dome shall be provided for all tank annulus monitoring and processing activities. These penetrations shall serve annulus pump pits, ventilation air inlets and outlets, instrument leads, annulus inspection, primary tank corrosion monitoring, and construction access.

Pipe risers extending up from penetrations in the primary tank and annulus not enclosed in pits shall terminate at or below grade, be protected by a traffic pad, and be shielded sufficiently to reduce personnel dose rates as specified in Section 5.1.4. The pads shall be designed to protect the risers from damage by any allowable traffic on the dome. Flanged riser extensions shall be used if needed to accommodate equipment that extends above grade.

Additional spare penetrations into the annulus and primary tank shall be provided including at least one spare for each size penetration or 10% of the total of each size, whichever is the greater. Tank penetration risers with above grade equipment shall be located or designed to permit crane access for all pit work. Appendix E contains a list of the required dome penetrations for the primary tanks and the annulus.

All risers not in use shall be sealed in a manner capable of withstanding a range of -12 to +60 in. of water pressure. The same pressure ratings shall apply to the seals between risers and installed equipment. Gasket seal material shall have a minimum radiation rating of 5×10^7 rads and have a permanent set of less than 10% in 15 yr. All risers shall be designed so that the connections of dissimilar metals are protected from corrosion. Observation risers in the annulus and primary tanks shall have air lock valves so they may be opened without affecting tank pressure changes.

2.4 INSULATING REFRACTORY

The layer of insulating refractory between the bottom of the primary tank and secondary liner shall have air passages for annulus ventilation airflow. Refractory must withstand operating temperatures of 250°F, and weight of primary tank filled with 1.16 Mgal of waste at a specific gravity of 2.0. Design shall address the potential problem of passage obstruction due to possible degradation of the insulating refractory.

2.5 OTHER SITE FACILITIES INTERFACE

Encased process pipelines to and from the cross-site transfer lines Diversion Box 2 shall be provided by the project. Additional diversion boxes, valve pits, and jumpers, etc. will be added as required. The Diversion Box 2 (reference Project W-058) is outside the scope of this project except for tie-ins.

2.6 CAPACITIES

The new tanks shall be designed to store approximately 1.00 Mgal of waste each.

2.7 TOLERANCES

Tolerances, including those construction tolerances defined on the engineering drawings and construction specifications, shall be developed, as required during definitive design.

2.8 RANGE OF DESIGN/OPERATING CONDITIONS

Refer to tables 1 and 2.

2.9 DEGREE OF RELIABILITY REQUIRED

The degree of reliability achieved by design shall permit the facilities to function throughout the intended life without undue maintenance or replacement.

2.10 DESIGN LIFE

The tank farm shall have a design life of 50 yr. Replaceable equipment and components may have a design life of a lesser number of years based upon availability, ease of maintenance, and economic considerations.

3.0 PROCESS DESIGN CRITERIA

3.1 INSTRUMENTATION AND CONTROL

Integral wall, dome, haunch, and base temperature sensing devices (redundant or replaceable) shall be installed in the reinforced-concrete structure to aid administrative control of thermal gradients in the reinforced-concrete structure resulting from processing and storage operations. Temperature sensing devices shall be located in the insulating refractory to provide similar control.

Temperature sensing devices, redundant liquid-level measuring devices, sampling devices, sludge level measuring devices, and probes to alarm high liquid levels shall be installed to monitor the contents of the primary tanks, as specified in Section 2.3.

Liquid detectors in the annulus space and air radiation monitors in the annulus ventilation exhaust shall be installed to detect leaks from the primary tank. Liquid detectors, liquid-level measuring devices, temperature sensing devices, and radiation detectors shall be installed in the leak detection pit to detect and measure leakage from the secondary liner to the concrete base slab. Leak detectors shall be installed in the central pump pits, annulus pump pits, flush pit, the main valve pit, leak detection pump pit, and service room. Leak detection pit radiation detection probes shall be moisture proof.

Stack effluent continuous air monitors and record air samplers shall be installed on both the primary tank and annulus ventilation exhaust stack(s) and systems to detect and measure radioactive and toxic material releases to the atmosphere. Alarms shall be provided for low flow or loss of sample airflow to the monitors. This alarm shall be separate and distinct from that for high radiation. Stack particulate air sampling shall be continuous and representative of the airflow in the system, provided by the near-isokinetic air sampling system.

A gas chromatograph probe shall be installed in each primary tank to measure concentration of ignitable and hazardous gases in the vapor space at various locations within the tank.

The device shall be able to detect and measure continuously the presence of hydrogen, carbon monoxide, hydrogen sulphide, carbon disulfide, nitrous oxide, ammonia and organic gases which might be generated in the waste stored in the tank.

A distributed control system (DCS) shall be required for control, monitoring, data acquisition and alarming of all process variables for the MWTF. The DCS shall be a functionally distributed, microprocessor-based modular system consisting of several multi-station control consoles, an engineering console, several local control units (LCU) and a redundant communications network and meet the human factors engineering criteria of DOE Order 6430.1A, "General Design Criteria," Section 1300-12, shall be applied. The control consoles shall consist of video display terminals (VDTS), printers and display copiers. The console design shall meet the requirements of MIL-STD-1472D. The LCUs shall be stand-alone control units, located in the field, which can operate independently of the control consoles. All control/monitoring logic shall be distributed at the LCU level. Redundancy, at this same level, for designated critical control/monitoring loops shall be required. No single failure shall prevent a safe shutdown or continued safe operation, as required, of a critical process system. This redundancy shall meet the requirements, including separation, of Westinghouse Hanford Company (WHC) WHC-CM-1-3, Management Requirements and Procedures (MRP) MRP 5.46 and meet the requirements of DOE Order 6430.1A, "General Design Criteria."

A minimum of 35% to 45% of process instrumentation shall be tied into a Supervisory Control and Data Acquisition (SCADA) system. Only the alarm and shutdown signals will be tied to the 200-East tank farm computer automatic surveillance system (CASS).

Selected, individually programmable instrumentation and interlock systems shall be provided for detection of leaks, pressure, and radiation, and to effect safe shutdown or to maintain safe operation of systems, as required. Valve positions shall be instrumented to read out on the DCS. On any jumper containing valves, the valve position indicators shall be a part of an engineered system which will ensure controlled waste transfer routings. Flow routing indicating devices, limit switches on the valves and/or pressure switches shall be provided on transfer lines discharging into the tanks as part of the engineered system to assist in the detection of misroutings. This engineered system shall be designed with interlocks so that it alarms, identifies the location, and shuts down the transfer pump initiating the transfer on indication of misrouting.

Instrumentation shall be designed for "fail safe operation" in the event of an air or electrical outage so that alarms are activated on signal failure. Radiation monitoring instruments shall have the "fail safe" feature of alarm on loss of ability to detect radiation. There will also be the use of radiation detectors to avoid any misrouting. Instrument and power cable runs shall be housed in separate raceways within the tank farm for protection and to facilitate future modifications. Any alarms outside in the tank farm that are required to be visual shall have high-intensity strobed indicators. Radiation monitoring capabilities shall be provided on steam, water, and/or air lines that come in contact with a radioactive environment or have potential for contamination, as required in Section 4.3.

Instrumentation shall be designed for the intended service and shall be qualified for the environmental conditions in which it is required to function.

Capability shall be provided for interfacing with the HWVP DCS for monitoring and control processes.

3.2 PIPING

3.2.1 Process Piping

The process piping and components shall be designed to safely transport the radioactive waste in accordance with ANSI B31.3. Process piping shall maintain a velocity of 3 to 10 ft/sec over a pump range of 32 to 100 gal/min to preclude solids from settling in the piping.

Separate dedicated incoming and outgoing waste transfer lines with associated spare lines shall connect the MWTF with existing facilities via the cross-site transfer lines Diversion Box 2. This process piping shall be provided with sufficient earth cover to reduce personnel radiation dose rates as specified in Section 5.1.4. Use of berms for radiation shielding shall be minimized as much as possible, and not permitted within the tank farm.

All process piping, valve pit drain lines, sample lines, drain lines, and primary ventilation system condensate drains shall be encased in secondary piping to collect and detect any leakage from the primary piping, unless determined otherwise during Definitive Design. Condensate from the primary ventilation system separate for each individual tank shall be recycled to the respective tank. All process lines shall be free-draining to prevent fluid accumulation in traps. Heat trace shall be used, if required, for freeze protection of piping. Encasement piping shall drain into the process pit on which they terminate. The process pits shall drain into the tank on which they are constructed. Encasements for process lines connecting the valve pits or diversion boxes shall be equipped with leak detection system.

In cases where the low points (or traps) can not be prevented by design in the process lines, a drain and collection system shall be installed at each low point to drain and/or collect the waste. These drains shall be routed to a catch tank. The fluid in the catch tank shall be pumped back to primary tanks.

The primary process piping and its encasement shall be provided with the capabilities for a periodic pressure test. Design shall restrict the use of a freeze plugging system for pressure testing. Pump pits for transfer line terminations at the tank shall be utilized to allow pressure testing capabilities. Leakage from the secondary liner (annulus) to the concrete base slab shall be collected by the leak collection system and transferred to the leak detection well by a drain line. Provisions shall be made for pumping liquids from the leak detection well to another tank.

Capability shall be provided for minimizing the use of line flush water in order to maintain a maximum waste oxide content in the HWVP feed.

Piping design criteria are summarized in table 3.

3.2.2 Process Pits

Primary processing pits, such as pump pits, leak detection pits, and the main valve pit shall be designed to house jumpers, pumps, and valves as required to achieve the necessary transfer capabilities. All process pits shall be designed to provide confinement of radioactive material and maintained at a negative pressure for confinement of airborne contamination. All process pits shall be designed for ease of decontamination and maintainability. All process pits shall be stainless steel lined. Cover block thicknesses for the processing pits shall be designed to reduce personnel dose rate at the surface as specified in Section 5.1.4. Provisions for flushing (raw water) the interior of each pit with the cover blocks in place shall be made. In addition, provisions shall be made for decontamination capability on selected equipment risers. Provision shall be made for the storage of jumpers and placement of cover blocks during equipment or instrument removal or rearrangement. Provisions shall be provided for the placement of a removable safety railing around the perimeter of all pits prior to removal of pit cover blocks.

The leak detection well shall be designed to accommodate addition of water to a predetermined level with provisions for sampling and adjusting the liquid level with the leak detection pit cover blocks in place. This feature will allow operational personnel to verify instrument operability and accommodate collection of leaked fluid.

The leak detection pump pit and the annulus pump pit shall be designed to accept the existing standard design for the tank farm leak detection and annulus pumps, (i.e. current design).

3.2.3 Jumpers

Jumpers and process line blanks required for MWTF shall be provided by this project. Existing jumper designs shall be used wherever practical.

Pipe nozzle blanks shall be provided to isolate tanks during long periods of nonuse.

All process valving shall be remotely positioned using motor actuators. All components located on the jumpers will be designed to minimize the amount of contact time required for repair and/or replacement.

Electrical connections between each jumper and the permanent terminal boxes at the process pits shall be remote electrical jumpers, or equivalent remote disconnects.

3.2.4 Corrosion Protection

Corrosion protection shall be provided for all underground metal piping and heating, ventilating, and air-conditioning ductwork in accordance with the Hanford Plant Standard (HPS) and in accordance with the recommended practices of the National Association of Corrosion Engineers (NACE). The system shall have a design life of 50 yr. The corrosion protection design shall be approved by a NACE certified corrosion person. The designed system shall also be compatible with the existing cathodic protection systems of the surrounding facilities, if possible.

3.3 GENERAL CHEMICAL PROCESS

Provisions shall be made for in-tank pretreatment processes. The design for pretreatment processes shall include an adjointing facility to prepare, store, and supply chemicals (sodium hydroxide/sodium nitrite solutions and flocculating agents) for in-tank sludge washing.

3.4 GENERAL MECHANICAL PROCESS

Each waste storage tank system shall be provided with an independent ventilation system. The ventilation for each tank system is divided into two subsystems: the primary tank ventilation system and the annulus ventilation system.

3.4.1 Primary Tank Ventilation System

The primary tank ventilation system equipment contained in a building (see Section 4.1.1, Ventilation Building) shall be connected via an encased underground stainless steel ductwork to a dedicated riser on the primary tank. Inside the Ventilation Building, the primary tank ventilation system shall be provided with a vapor condensing system cooled by the closed-loop cooling system, moisture eliminator equipment, and redundant trains of high-efficiency metal fiber (HEMF) filters or high-efficiency particulate air (HEPA) filters. A redundant set of exhaust fans shall be provided to discharge filtered air to a stack from a common header downstream of the fans. The water vapors removed by the condensing system shall be recycled to the respective primary tank. Each primary tank shall also be provided with an air intake system equipped with HEPA or HEMF filters to provide adequate supply of air into the tank vapor area for operation of the primary tank ventilation system within the range of tank pressure specified in table 1. Heaters, condensers, moisture eliminator equipment, HEPA filters, and exhaust fans shall be located in concrete cells or enclosures for confinement of radioactivity and for shielding, as specified in Section 4.1.1.

Other safety devices shall be installed in the primary ventilation system to prevent collapse of the primary tank under excessively high vacuum.

Each primary tank ventilation system in conjunction with the annulus ventilation system shall be designed to remove heat at a maximum rate of 2.6

MBtu/hr. The system shall be designed to operate efficiently over the anticipated operating range from 0 MBtu/hr to 2.6 MBtu/hr. The waste in the primary tank will be composed of varying proportions of sodium hydroxide at a concentration of up to 8.0M and suspended solids mainly in the form of hydrated metallic oxides, metallic hydroxides, and phosphates. To minimize the buildup of solids at the tank bottom and to enhance heat transfer, the primary tank shall be designed to accept a waste-mixing system, as specified in Section 3.4.5.

The design of the primary tank ventilation system shall also incorporate the features listed below:

- Instrumentation readouts and displays shall be as specified in Section 3.1.
- All equipment components shall be arranged to facilitate remote maintenance with provisions for access, decontamination, shielding, removal, lubrication, and testing for performance and calibration.
- Active winter protection for all heating, ventilating, and air-conditioning instrumentation, ductwork, drains, and seal pots shall be provided, as required.
- Features shall be provided to prevent moisture accumulation on the HEPA and HEMF filters including means to prevent frost accumulation on intake filters.
- Instrumentation for measuring pressure differential across, and for in-place testing of individual HEPA and HEMF filters shall be provided. Gauges and instruments shall be located and/or suitably protected to prevent moisture accumulation in the system.

- Instrumentation for monitoring tank discharges shall be provided, as specified in Section 3.1.

- Near-isokinetic air-sampling system for sampling particulates on the primary tank exhaust shall be provided as specified, in Section 3.1.

- Shielding shall be provided for the HEPA and HEMF filter system equipment in the primary tank ventilation system to reduce personnel dose rate as specified in Section 5.1.4.

- Stainless steel ductwork consisting of all welded construction, and provided with the thermal expansion joints which will function under all anticipated operating conditions, shall be provided.

- Features shall be provided to reduce accumulation of deposited solids, such as ammonium nitrate, on the HEPA and HEMF filters.

- Safe access to all areas of operation including ladders, walkways, platforms, etc. shall be provided.

- Sampling and monitoring in accordance with DOE, Environmental Protection Agency (EPA), Federal, State, and WHC requirements shall be provided (see Section 3.4.6).

3.4.2 Annulus Ventilation System

The annulus ventilation equipment shall be located above grade and protected from weather effects, as required. The system shall consist of redundant trains of exhaust HEPA or HEMF filters, and a set of redundant exhaust fans discharging to a common header prior to release to a stack. The annulus ventilation exhaust stack should be separate from the primary tank ventilation exhaust stack unless indicated otherwise during the design.

The design of the annulus ventilation system shall incorporate the features listed in Section 3.4.1 for the primary ventilation system except for features to reduce accumulation of deposited solids.

Provisions shall be made to divert the annulus exhaust to the primary ventilation system in the event a leak from primary tank to the annulus is indicated.

3.4.3 Tank Corrosion Monitoring

The primary waste storage tanks shall be monitored for corrosion damage during their service life. The following methods shall be used to perform tank monitoring:

- Design shall be based on the corrosion monitoring program, WHC-SD-WM-EV-054.

  The corrosion coupons are to provide a means of evaluating localized corrosion effects such as pitting and stress corrosion cracking.

  Corrosion coupons with welds similar to and made using the same welding procedures and material as the tank welds shall be installed. These corrosion coupons shall be easily removable during inspections. One of the corrosion coupon assemblies shall rest on the bottom of the tank, and one corrosion coupon assembly shall be designed to float on the tank contents to hold corrosion coupons at the liquid/gas interface.

- Remotely replaceable electronic resistance corrosion probes and associated monitoring instrumentation. The probes shall have a minimum of 5 yr design life.

- The configuration of the primary tanks shall allow for internal and external visual tank inspections. The entire tank exterior plates (except the top and bottom) shall be inspectable. The purpose of these inspections is to provide a back-up to the other corrosion evaluation methods for monitoring tank integrity. The project will provide the inspection system.

3.4.4 Waste Transfer

Each primary tank shall be provided with a transfer pump by this project. The transfer pump shall be utilized for waste transfer, and shall have a minimum discharge of 160 gal/min with a discharge head of approximately 190 ft.

Each tank shall be provided with a supernatant transfer pump, in addition to the waste transfer pump. The supernatant transfer pump is required to transfer the supernate generated during sludge washing for the pretreatment process in the tank.

The HWVP tank pumps shall, at a minimum, provide feed on demand, perform transfers of feed to the initial HWVP feed adjustment and concentrate system, as required. The design shall provide for controlled and measured flow.

One dummy pump head shall be provided for each primary tank. This apparatus will provide a mounting bracket for the pump-related jumper, and also provide a pipe routing for any drainage from the pipeline to the tank when the pump is not present.

Features shall be provided to maximize the quantity of waste that can be moved with the transfer pumps. The remaining tank heel, below which the transfer pumps will not function shall be 2%, or less if feasible, of the tank working volume.

Features shall be provided to enable installation of equipment for maintaining a top-to-bottom tank homogeneity and minimizing the transfer-to-transfer variability in physical properties and chemical composition over the entire contents of the tank. The requirements will be assumed to be met by providing six (6) (42" Ø) pump risers and six (6) intermediate (24" Ø) spare risers for the future installation of mixing equipment as may be determined to be necessary.

The HWVP feed transfers will provide a continuous recirculation transfer which must meet a certain level of feed uniformity over a process campaign in order to maintain process efficiency and glass product quality specifications. The HWVP goals are to achieve a feed physical and chemical homogeneity of at least 98% of actual tank contents during all transfers and an ability to process at least 98% of the tanks contents. The MWTF will provide system physical features to support HWVP goals as defined in this and other sections. The HWVP Project, through its own activities, is responsible for demonstrating that it's goals have been met.

3.4.5 Mixing System

Each waste tank shall be designed for a mixing system capable of maintaining solids in suspension. Minimum settling should be allowed to facilitate tank transfers and clean out in order to maintain physical and radiological properties and radionuclide content of the waste as given in Appendix A. The mixing system will also enhance heat dissipation from tank contents to the primary tank ventilation system. The requirements will be assumed to be met by providing six (6) mixer pumps with 300 hp capacity.

3.4.6 Sampling System

Waste management operations are routinely evaluated by sampling and analyzing waste storage tank contents. A sampling system shall be provided to obtain samples from the primary tanks. The sampling system shall meet the following functional and operational requirements.

- Obtain a representative sampling of the contents of each tank. A minimum of three sample points, each at a different elevation, shall be provided.

- The sampling system shall be capable of obtaining a representative sample at any time to characterize the tank contents. HWVP/Pretreatment waste may range within the limits defined in Appendices A, B, and C.

- Provide contamination control and adequate radiation shielding for all sampling operations.

- The sampling system shall be remotely operable and maintainable.

- Provide remote internal and external decontamination of the sampling equipment and sampling lines.

- Provide capability to remotely clear and flush sample lines with water, air, steam, and/or decontamination solutions.

- Sample return lines shall slope to the return point. Sample supply lines shall slope to the supply point.

- Provide a means of removing samples from the sample area through a double contained system suitable for manual transport.

- Remotely return or re-circulate the sample stream to its point of origin or other suitable location.

- Provide access for transfer of equipment and direct maintenance via ceiling hatches, or shielded and sealed doorways.

- Provide a method of remotely transferring small parts, bottles, small tools, etc. into the sample cubicle. Maintain contamination control during transfer operations.

- Provide and locate master slave manipulators for convenient use in sampling and maintenance operations. Manipulators must reach all areas of the sample cubicle.

- Provide shielded viewing windows. As far as practicable, remote operating and maintenance tasks shall be located within the normal viewing angle of the window. Viewing angles from adjacent windows shall overlap.

The location of the sample system shall be dependent upon facility layout; however, consideration shall be given to minimizing solution lift and sample line lengths.

3.4.7 Waste Liquid Balance

Humidity meters shall be provided upstream of the condensers and downstream of the HEPA or HEMF filters in the primary tank ventilation system, along with the flowmeters in the condensate return line. These measurements are required to aid in estimating the net loss of water from the primary tank and the amount of water to be added to maintain the physical characteristics of the waste in the tank within the specified limits.

3.4.8 Leak Detection

Leak detection systems shall be installed for detection of leaks in the waste storage tanks, process lines, and pits in accordance with the requirements of the Federal, EPA, and State regulations. Instrumentation for the leak detection systems shall be provided as specified in Section 3.1.

3.4.9 Leakage Removal

Design shall provide for means to remove any material leaked into the annulus from the primary tank, from the annulus to the concrete base slab, or from the transfer lines to the encasement piping and pits, in compliance with Resource Conservation and Recovery Act and State regulations.

4.0 FACILITY DESIGN CRITERIA

4.1 ARCHITECTURAL

4.1.1 Ventilation Building

The project shall provide a building (i.e., Ventilation Building) which houses the primary tank ventilation system equipment and performs the function of the secondary confinement for any potential release of radioactive or hazardous material from the primary tank ventilation system to the environment. The Ventilation Building shall be provided with a heating and ventilation system equipped with HEPA or HEMF filters to prevent uncontrolled release of contaminated air to the atmosphere (see Section 4.2.1.) Any release of contaminated liquids to the Ventilation Building shall be fully confined and returned to the primary tank by a drain system included in the design.

The major components of the primary tank ventilation system shall be located in separate cells to provide isolation of the individual equipment for maintenance and replacement. The cells shall be concrete structures. The walls and the floor of the cells shall be lined with a stainless steel liner to preclude any leak from the cells to the environment. The roof of the cells shall consist of removable coverblocks for removal of the equipment from the cells and provide entry for the facility workers into the individual cells.

The controls for the equipment inside the cells shall be located outside the cell walls in an operating gallery. The cell walls and the coverblocks shall be designed to provide the required radiation shielding for the facility workers in accordance with criteria specified in Section 5.1.4.

All piping carrying radioactive effluents shall be located in shielded pipe tunnels, be spark resistant, and electrically ground/bonded.

The layout of the Ventilation Building shall be developed to provide controlled entry to and exits from various areas of the building so as to prevent spread of contamination. Adequate storage area shall be provided for storage, packaging and shipment of contaminated solid waste, and for collection of reusable contaminated clothing and tools. Enough space shall be provided for laydown of contaminated equipment for maintenance and the maintenance crew to work with minimum exposure to radiation or toxic material. Provisions shall be made for operating personnel and services as specified in Section 5.8.

4.1.2 Control Room

The design shall provide a control room either inside or adjacent to the Ventilation Building, with easy and safe access to the operating gallery in the event of an emergency that requires facility operation or control from the operating gallery. The control room shall be designed to accommodate the equipment required for instrumentation and control of the facility as specified in Section 3.1.

4.1.3 Diesel Generator Building

The design shall provide a building either part of or adjacent to the Ventilation Building to house the diesel generator(s) to supply safety related backup power, diesel fuel storage tank, batteries and battery chargers for Uninterruptible Power Supply (UPS), and safety related cables and switchgear. The diesel fuel storage tank may be located outside the Diesel Generation Building.

4.1.4 Sample Building

The design shall provide a Sample Building equipped with ventilated glove boxes or a cell equipped with manipulators for collecting samples for measurements. This facility shall be common for all the four waste storage tanks.

4.1.5 Service Area

The design shall provide a Service Area to supply raw water and steam as required by the MWTF systems, including a flush pit equipped with hose connections. The area shall be provided with heaters for freeze protection and radiation monitoring/alarm system to detect contamination.

4.1.6 Air Compressor Room

The design shall provide a room inside or adjacent to the Ventilation Building or Service Area to house the air compressors, which supply air to the seal loops and other MWTF systems, as required.

4.1.7 Weather Enclosure

A permanent enclosure shall be provided over the top of the four new tanks which will provide weather protection. The weather enclosure must have the following features.

- Provide protection from the weather elements (snow, wind, rain) for miscellaneous equipment associated with the waste storage tanks and personnel working inside the enclosure.

- Provide weather protection for any and all equipment required for remote inspection and maintenance activities.

- Provide lighting and receptacles for maintenance and inspection activities.

- Provide at least one hollow-metal personnel door and one electrically operated, roll-up steel door of sufficient size to accommodate the required maintenance vehicles.

- Provide access to allow for installation and removal of equipment while keeping the enclosure height as low as practical.

- Provide a paved floor for prevention of dust, and sealed to facilitate cleanup of potential spillage. The weather enclosure performs no additional confinement functions.

- Provide a minimum HVAC (40° minimum 90° maximum) to support year around operational requirements.

- Inside walls must be capable of being decontaminated.

4.2 HVAC

4.2.1 Ventilation Building

A Heating, Ventilation and Air Conditioning (HVAC) system shall be designed for the Ventilation Building. The HVAC system shall be equipped with a set of redundant HEPA of HEMF filter trains and exhaust fans discharging into the primary tank ventilation stack downstream of the exhaust fans. The HVAC system shall be designed to preclude release of unfiltered air from the Ventilation Building to the environment.

The flow of HVAC air shall be from cleaner areas to the higher contaminated areas to prevent spread of contamination inside the Ventilation Building. The building shall be divided into 4 zones in accordance with the levels of contamination. Zone 4 shall be assigned to the contamination-free areas, such as the control room, offices and the lunch room. Zone 1 shall be assigned to the area with the highest level of contamination, such as the concrete cells. The operating gallery shall be designated as Zone 3. Zone 2 shall be assigned to areas which have contamination level between Zone 1 and Zone 3 levels.

The Ventilation Building HVAC system shall also provide temperature and humidity controlled conditions in offices, personnel facilities and work area, in addition to the areas where equipment sensitive to excessive weather environment is located.

4.2.2 Other Buildings

Other buildings or rooms which are not generally contaminated but have high potential for contamination shall be provided with an HVAC system similar to the HVAC system for the Ventilation Building.

The buildings which are contamination-free and have no potential for contamination shall be provided with a conventional HVAC system, as required.

4.3 UTILITIES

4.3.1 Compressed Air

Compressed dry/oil free air shall be provided from dual compressors with closed-loop cooling systems, provided with automatic switch over capabilities in case of equipment failure. Each compressor shall be capable of supplying at least 150% of that required by the facility.

4.3.2 Raw Water

Raw water shall be provided for flushing purposes and clean out of process lines. Backflow prevention, flow measurement, strainers, pressure relief valves, and radiation detection devices shall be provided on raw water supply lines. Backflow shall activate an alarm in the control room.

4.3.3 Steam

Provisions shall be made for the supply of steam, equipped with flow and pressure measurement, backflow prevention and radiation detection devices, as required.

4.3.4 Sanitary Water

Sanitary water shall be provided as required.

4.4 LIGHTING

Lighting for the exterior of the facility shall be provided by the use of photo-cell operated, wall-mounted, low-pressure sodium light fixtures. The entire perimeter of the building, personnel doors, and roll-up doors shall be provided with adequate lighting for personnel safety, security, and emergency response vehicles. The exterior perimeter of the buildings shall be provided with a minimum illumination of 5 footcandles. All exterior lighting shall be low-pressure sodium light fixtures.

Emergency fixtures shall be provided which will provide sufficient lighting for personnel to egress the buildings. Battery operated, incandescent lighting shall be provided as required.

Personnel doors shall have lighted exit signs placed above the doors. Exit sign design shall be such that when normal power fails the backup power source will provide power. Tritium energized exit signs shall not be used.

Emergency lighting shall be provided in areas, such as control room and operating gallery, which are required for operation or control of the facility in emergency conditions. All discharge lighting, ballast type, shall have a power factor of 95% or better.

4.5 ELECTRICAL

4.5.1 General

Electrical systems design and installation shall conform to the National Electrical Code (NEC), National Fire Protection Association (NFPA), NFPA 70. No equipment or material containing mercury or polychlorinated biphenyls (PCB) shall be used. To the extent possible, all electrical equipment shall be isolated from mechanical equipment. Electrical systems shall be sized to provide 20% spare capacity.

The Hanford Circuit and Raceway Schedule shall be implemented to the maximum extent possible, including fire protection circuits, HVAC circuits, communications circuits, data circuits, air compressor circuits, and vendor design packages.

All wires of control circuits shall be numbered on design documents and shall be identifiable when installed. Lighting circuits, receptacle circuits, power supply circuits, and heat trace circuits shall be identified with the originating panel identification and corresponding circuit breaker as a minimum.

Where applicable, the equipment shall be designed to operate in a radiation field. The radiation field for the different areas shall be determined during Definitive Design. The photon-energy spectrum developed from the waste characterization and the designed shielding shall be used in determining the radiation fields.

All safety switches and circuit breakers, including 208Y/120V panelboards, shall be equipped with provisions for locking out where commercially available. All in farm wiring will be underground in raceways, this in both electrical and instrument. Electrical and instrument will be in separate wireways.

Safety Class 1 or 2 loads which require backup power shall conform to the guidance given in the WHC, document WHC-SD-GN-DGS-303, "Backup Electrical Power System Definitions and Design Criteria". The design shall minimize single active failures in conformance with Institute of Electronic and Electrical Engineers (IEEE), IEEE 379 criteria, and shall provide independence of Safety Class 1 circuits, if used in the design, in conformance with IEEE 384.

Backup power for Safety Class 1 items, components, and/or systems shall meet IEEE Class IE criteria.

4.5.2 Unit Substations

Double-ended unit substations shall be provided with two interrupter switches, two transformers, and two low voltage switchgear busses with a normally-open tie breaker. Primary voltage shall be 13.8 kV, and secondary voltage shall be 480Y/277 V. Either half of the substation shall be capable of carrying the total electrical load of the facility.

The normal power sources shall be metered and shall utilize digital metering technology. Metering shall, as a minimum, consist of amperes, volts, watt-hours, and watt-hour demand with a 15 to 60 minute, minimum, data collection interval.

The circuit breakers shall be electrically operated, at the substation.

The circuit breakers shall be capable of being racked out and isolated from the substation buses for purposes of replacement, modification, repair, or routine preventive maintenance while the rest of the substation remains energized.

It shall be possible to isolate each individual transformer for repair, replacement, or routine preventive maintenance.

4.5.3 Normal Power

The MWTF shall be designed to use 208Y/120 Vac and 480Y/277 Vac, three-phase, 4-wire electrical distribution systems. To the maximum extent practicable, the lighting circuits shall operate at 277 V.

Electrical equipment (e.g., transformers, load centers, motor control centers, distribution panelboards) shall be provided to distribute the electrical power required to operate the facility. The unit substation transformers shall be delta-wye, liquid-filled, standard impedance units; all other power transformers shall be dry type units.

4.5.4 Backup Power

When the normal power source fails, a backup power source(s) shall be available so that the designed safety features identified by the safety analyses shall remain functional. The backup power source(s) shall meet the requirements specified in WHC-SD-GN-DGS-303. The final list of loads for backup power shall be determined during Definitive Design. In general, the backup power source(s) is (are) needed to:

- Prevent loss of life or life threatening injuries.
- Prevent onsite or offsite radiation in excess of guidelines.
- Provide instrumentation necessary for safe operation or safe shutdown of the facilities.
- Prevent loss of radiation monitoring and leak detection capability.
- Prevent major equipment damage.
- Prevent long-term shutdown of the facility.

Accordingly, backup power shall be provided for, but not limited to, the following:

- Wherever it is required by the NEPA (such as for emergency egress lighting).
- Fire alarms.
- Evacuation alarms.
- Stack monitoring systems (radiation instruments, gas analyzers, etc.).
- The DCS and process computer.
- Liquid level monitors for the tanks.
- Liquid-level monitors for leak detection pits.
- Ventilation filtering equipment including exhaust fans.
- Area radiation monitors.

The DOE Order 6430.1A further requires that all radiation monitoring, alarm, and warning systems that are required to function during a loss of normal power shall be provided with an UPS unless it is demonstrated that (1) they can tolerate a temporary loss of function without losing needed data and (2) they are provided with backup power.

Upon loss of normal power, the required loads shall be transferred to backup power, once the backup power is online and available. Backup power shall consist of safety class, emergency, and/or standby power systems as defined in WHC-SD-GN-DGS-303) for Safety Class 1, Safety Class 2 and Safety

Class 3 or 4 loads, respectively. The backup power systems shall be assigned the same safety classification as the loads they serve, as shown in Appendix D. In accordance with the guidance given in WHC-SD-GN-DGS-303, the "emergency power systems", required for Safety Class 2 loads, shall be designed as specified in NFPA 70, NFPA 101, NFPA 110 and IEEE 446.

A contact closure signal shall be sent to MWTF DCS to indicate when the emergency motor control centers (MCC's) are being fed by the backup power system. The DCS shall provide a sequential start program for all Safety Class 2 loads when re-energized by backup power on loss of normal power. Safety Class 1 loads, if required by design, shall have qualified (non-DCS) start-up controls provided to re-energize the loads with backup power on loss of normal power.

UPS's shall be localized and designed to supply UPS power to individual equipment, instead of having a single UPS power source supply power to a UPS systems. Failure of UPS systems in the event the UPS fails would mean loss of power to all equipment requiring uninterruptable power.

4.5.5 Receptacles

Electrical receptacles for the distribution of 120 Vac shall be provided throughout the facilities, interior, and exterior. Welding receptacles (480 Vac) shall be provided, as required.

4.5.6 Grounding

4.5.6.1 General Grounding

The general grounding system for the grounding of electrical equipment, structural components, shielding windows and their wall liners, equipment, structural steel, metal stairways, etc. shall consist of a dual wire loop around the structure or facility. The dual wire loop around the building shall have an ohmic value of less than five ohms by using the Ratio-Method, (Beeman - Industrial Power Systems Handbook). If less than five ohms can not be obtained by the dual wire loop around the building or facility, additional electrodes reaching into the ground water table shall be installed at opposite ends of the dual wire loop.

If there is more than one structure or facility requiring the dual wire loop, the dual wire loops of each structure or facility shall be connected by a minimum of two wires. Each of the dual wire loops around the structures or facility shall have an ohmic value of less than five ohms before being inter-connected.

From the dual wiring loop around the structure or facility, a minimum of two wires shall enter the structure or facility for grounding in accordance with applicable articles NEC-250. All switchgear, motor control centers, etc. shall be grounded at both ends. Grounding pads shall be installed wherever possible for general purpose grounding. All grounding mats shall be tied to the cathodic protection system.

4.5.6.2 Instrument Ground

An instrument ground system with dedicated grounding electrodes for the grounding of analog/digital systems shall be installed. The instrument grounding system shall be in conduit and insulated wire in the structure or facility as needed. The conduit and insulated wire from the instrument grounding electrodes shall run to a conveniently located junction/terminal box in the structure or facility containing an insulated instrument ground bus and a general ground bus. At this junction/terminal box, the instrument ground bus and the general ground bus shall have one bolted wire bonding. The instrument ground system in the structure or facility for the grounding of analog/digital systems shall be connected to the insulated instrument ground bus in the junction/terminal box. The analog/digital ground network shall be detailed and shown on facility drawings.

The ohmic value of the instrument grounding electrodes shall be less than five ohms established by the Ratio-Method.

4.5.6.3 Lightning Protection

A lightning protection system that provides positive lightning protection for the process system and storage tanks shall be installed in accordance with NEC 250-86 and Lightning Protection Code NFPA-78.

The bonding required per NEC 250-86 and the NFPA-78 shall be a bolted connection, accessible for inspection, in an underground handhole, and near the lightning protection grounding electrodes. The lightning protection down conductors, from the lightning arrester air terminal or lightning arrester array, shall use the most direct route to the lightning protection grounding electrodes.

The structure or facility general grounding system shall not be used as a down conductor link. The lightning protection grounding electrodes shall have an ohmic value of less than one ohm determined by the Ratio-Method. The lightning protection grounding electrodes, the lightning protection down-conductors, the lightning arrester air terminals and/or lightning arrester array shall be shown on facility drawings.

4.5.7 System Design Power Factor

The general requirement is for the normal, standby , and uninterruptable power supply distribution systems to meet a minimum design power factor of 0.95.

Motors and loads fed via the electrical distribution system shall meet the design power factor of 0.95. The use of high efficiency motors, high efficiency lighting ballasts, variable-speed drive controllers, capacitors (for power factor correction), or other proven measures will be required.

4.6 ENERGY CONSERVATION

Criteria given in DOE Order 6430.1A, Section 0110-12 shall be applied in the design with the following objectives:

- Minimizing consumption of nonrenewable energy sources on the basis of Life Cycle Cost Analysis (LCCA) effectiveness.
- Encouraging the use of renewable energy sources.

Employee health, safety, and environment (including indoor air quality) shall not be compromised in achieving energy efficiency.

4.7 MAINTENANCE

4.7.1 Facility

The MWTF shall be designed to facilitate access for maintenance and to preclude excessive downtime.

4.7.2 Equipment

Filter change systems concepts shall facilitate confinement during filter changes. Filter enclosures shall be designed with unobstructed access to bag-out openings for minimal personnel exposure during filter changes. Filter change systems which employ remote changeout capabilities shall facilitate confinement during filter change and also provide for minimal personnel exposure. The housing for exhaust air-sampler instrumentation shall be designed for unobstructed access and minimal personnel exposure during sampler filter changes.

The location of above grade fences, buildings, risers, instrumentation, and electrical apparatus shall accommodate routine access to the process pits with a crane and 60-ft trailer and space provided adjacent to the pits so that the coverblocks can be stored without moving the crane.

Above-ground equipment and systems will be capable of in-place preventive maintenance, repair, and calibration, where applicable. The design should facilitate access to, and removal of, equipment with shielding provided as necessary.

Equipment, instrumentation, detectors, and systems located in pits or tanks, including annulus area, shall have remote test and examination capability to determine performance and condition. The process equipment and instrumentation must be capable of being remotely removed and replaced. Rotating equipment not readily accessible shall be remotely lubricated.

4.7.3 Materials

The project shall prepare a list of spare parts and replacement parts, including the purchase specifications for those parts based on the original design and the vendor information on equipment installed in the facility.

5.0 GENERAL REQUIREMENTS

5.1 SAFETY

The hazards which need special consideration in the design of MWTF are the confinement of radioactive and chemical materials, airborne particulates, radiation exposure, and industrial hazards to personnel. New structures, equipment pits, equipment, and piping will be designed to provide confinement of radioactive solutions. Although personnel occupancy will not be continuous in the contaminated area, personnel will be protected from radiation by adequate shielding provided by cover blocks or earth cover. A radiation monitoring checkout station shall be provided for personnel leaving the MWTF. Safety documentation will define the management, design, and process controls which will ensure safe operation of the facility.

Releases to the environment by the facilities will be via the ventilation system which is equipped with HEPA filters and continuous release monitoring system. The design shall assure that any ignitable gases generated in the tanks do not form an ignitable or explosive mixture inside the tanks or anywhere else in the primary tank ventilation system, by limiting the concentration of the gases or vapors in the system to less than 25 percent of their lower flammable limit.

The acceptability of system design and operation under normal conditions, to include all features of performance alternates (e.g., redundancy, by-pass administrative controls) shall be evaluated by taking into consideration single active failures of components.

The effects of component failure, including control and monitoring, utility failure (e.g., power sources, air and vacuum supplies) shall be evaluated and special safety features incorporated in the design in accordance with the requirements of DOE Order 6430.1A. A safety analysis report shall be prepared as required by DOE Orders 6430.1A and 5481.1B, ensuring that the risk to the public, environment and the site workers during normal and anticipated accident conditions is below the limits set forth in DOE orders, and EPA and State regulations.

MWTF shall be considered a Moderate Hazard Facility.

5.1.1 Criticality

An analysis shall be performed to assess potential for criticality during definitive design. If a potential for criticality is found to exist, special features shall be provided by the design for prevention of criticality in accordance with DOE Order 6430.1A, Section 1323-3. Credit may be taken for administrative controls, as permitted by the DOE regulations.

5.1.2 Radiation Protection

5.1.2.1 General Radiation Protection

Health Physics requirements contained in WHC Manual (WHC-CM-4-10) shall be satisfied by the MWTF design.

Direct radiation monitors and air contamination monitors, with alarms, shall be provided by this project in accordance with the Department of Energy, Richland Field Office (RL) Order RL 5480.11A, "Requirements for Radiation Protection." Signals from radiation and effluent monitoring systems shall be connected to the DCS, and also alarmed/displayed in the control room.

5.1.2.2 Radiation Protection Optimization

Evaluations and cost-benefit analyses for determining that the radiation exposure levels are as low as reasonably achievable (ALARA) shall use the methodologies established in International Commission on Radiological Protection 37, "Cost-Benefit Analysis in the Optimization of Radiation Protection." The human factors engineering criteria of DOE Order 6430.1A, "General Design

Criteria," Section 1300-12 shall be applied for work with equipment and facilities containing radioactive materials.

5.1.2.3 Criteria for Control of Occupational External Radiation Exposure

The radiation field at any continuously occupied locations shall be ALARA and shall not exceed 0.2 mR/hr maximum based on the radioactivity concentrations given in Appendices A, B, and C and from all contributing sources including, but not limited to, the primary tanks, ancillary facilities, and transfer piping and equipment.

Remote maintenance, inspection and testing capabilities shall be incorporated in the design of facilities and equipment. Radiation exposures associated with proposed alternatives shall be shown to meet ALARA requirements.

5.1.2.4 Criteria for Control of Occupational Internal Radiation Exposure

Airborne radioactivity and surface contamination shall be controlled by incorporating confinement of process solutions, aerosols, and gases, during all foreseen normal operation and maintenance activities into the design of the facilities and equipment. Release of radioactive/hazardous materials into accessible locations shall be minimized.

In no case shall the airborne radioactivity concentrations in accessible locations exceed one-tenth the derived air concentration values listed in the DOE Order 5480.11 "Radiation Protection for Occupational Workers," as adjusted for all radionuclides present.

Personnel decontamination capabilities shall be located sufficiently close to operating and maintenance locations so as to eliminate the possibility of personnel passing through uncontrolled areas.

Access points to zoned areas shall be equipped with personnel radiation monitors which meet the requirements of the DOE-RL Order RLIP 5480.11, "Requirements for Radiation Protection for Occupational Workers." Facilities which provide confinement for radioactive contamination shall be equipped with HEPA filtered exhaust ventilation.

5.1.2.5 Criteria for Control of Nonoccupational Radiation Exposure

Any leakage of process or decontamination solutions shall be contained and handled as radioactive waste.

No member of the public shall receive an effective dose equivalent greater than 100 mrem/yr (50 mrem/visit) from exposure during direct onsite access at a DOE facility. This limiting value includes the committed effective dose equivalent from internal irradiation and any external irradiation as defined in WHC Manual (WHC-CM-4-10) in accordance with DOE Order RLIP 5480.11.

5.1.2.6 Criteria for Radiation Exposure to Public

The maximum dose equivalent received by any member of the public shall be ALARA. The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year an effective dose equivalent greater than 100 mrem in accordance with DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

5.1.3 Contamination Control

The MWTF shall be designed in accordance with the criteria given in DOE Order 6430.1A, Section 1300-7 by providing confinement barriers and air filtration systems for contamination control.

5.1.4 Shielding

Calculations for shielding shall use photon-energy spectrum developed from the waste characteristics given in Appendices A, B, and C.

The radiation field at the exterior of any above grade structures in any area with uncontrolled access shall not exceed 0.05 mrem/hr on average, as specified in WHC Manual (WHC-CM-4-9) in accordance with the RL Order RL 5480.11A.

The radiation field at the surface of below-ground structures where they contact the soil in the controlled access areas shall not exceed 0.2 mrem/hr on the average, as specified in WHC Manual (WHC-CM-4-9) in accordance with RL Order RL 5480.11A.

5.1.5 Industrial

The facility shall be designed in accordance with the industrial safety requirements of Occupational Safety and Health Administration, Code of Federal Regulations (CFR), 29 CFR 1910, DOE Orders 6430.1A, and DOE Order RL 5480.1B, "Environmental Safety & Health Program for the DOE Operations." The design shall ensure that a single failure does not result in the loss of capability of a safety class system to perform its safety function.

The facility shall not be constructed of hazardous materials if possible. The architect-engineer shall submit to WHC, for approval, the justification for use of any hazardous material, as defined by the EPA and WAC-173-303, prior to incorporating into the design.

The applicable NFPA codes including codes NFPA 241, "Safeguarding Building Construction and Demolition," and NFPA 101, "Life Safety Code," shall be applied to this project.

5.1.6 Fire Protection

Fire protection shall be provided for the new MWTF. The facilities shall be protected by an automatic sprinkler systems in accordance with NFPA 13. Hand-held fire extinguishers shall also be provided throughout the facilities. Fire alarm activation devices that are compatible with and connected to the existing site fire alarm system shall be provided as required. Redundant fire detection will be provided throughout the buildings. Fire alarm activation devices shall include both manual and automatic. The water supply for permanent fire protection installation shall have two reliable, independent sources each with sufficient capability for fire fighting until other sources become available. One of the paths shall be qualified in accordance with SDC 4.1.

The fire protection system and/or equipment shall be Underwriters Laboratories listed or Factory Mutual approved, and meet all applicable codes, standards and DOE Orders.

5.1.7 Traffic Safety

The facility design shall take into consideration traffic into, around, and out of the facility, particularly during an emergency situation.

5.2 ENVIRONMENTAL PROTECTION

5.2.1 Regulatory Compliance

The design of the MWTF shall comply with the requirements of 40 CFR 260, "Hazardous Waste Management System: General," 40 CFR 261, "Identification and Listing of Hazardous Waste," 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." The design shall also comply with all other applicable State and Federal laws and standards, including applicable waste volume reduction requirements.

Only new construction items shall meet Resource Conservation and Recovery Act and all other applicable State and Federal laws and standards. All existing systems or portions of existing systems not modified by this project may not be required to meet all applicable State and Federal laws and standards, including Resource Conservation and Recovery Act.

5.2.2 Environmental Releases

Releases of radioactive material and nonradioactive hazardous material shall not exceed the criteria given in WHC Manual (WHC-CM-7-5). Release of radioactivity from the facility shall not exceed 5,000 times the Derived Concentration Guidelines (DCG's) specified in DOE Order 5400.5, Chapter III at the point of discharge during abnormal operating conditions.

5.3 SAFEGUARDS AND SECURITY

The 200-East Area boundary fence shall contain the tank farm within the 200-East Area. All new facilities shall be designed to comply with the DOE Order RL 5632.6, "Physical Protection of DOE Property and Unclassified Facility."

A temporary construction fence shall be provided for the facility site during construction. This fence may also encompass the construction workers parking lot, the equipment lay down area, and the excavation spoils area.

5.4 NATURAL FORCES

5.4.1 Design Considerations

The facility structures, systems, and components important to safety shall be designed taking into consideration the loads generated by seismic events and other natural phenomena. The design criteria given in HPS, Standard Design Criteria, SDC-4.1 shall be applied in analyzing structural integrity of those structures, system, and components.

5.5 DESIGN FORMAT

Drawings shall be prepared according to the formats set forth in SDC-1.3, "Preparation and Control of Engineering and Fabrication Drawings".

5.6 QUALITY ASSURANCE

5.6.1 Quality Assurance A/E

Quality Assurance (QA) requirements for all contractors involved in the design, construction, inspection, testing and acceptance of the proposed facility shall be formulated and executed to provide assurance that the facility is designed and constructed as intended. The Project Specific Quality Assurance Program Plan (QAPP) shall be prepared to assure that the design is developed in accordance with the criteria set forth in this document, that the construction is performed in accordance with design, and that the inspection, testing and overview acceptance activities confirm the adequacy of the design and construction. The QAPP requirements shall be in accordance with DOE Order 5700.6C "Quality Assurance".

5.6.2 Level

Functional safety classification of systems, components and structure shall be used as the basis for Hanford Quality Assurance requirements as defined in the WHC, "Management Requirements and Procedures Manual," WHC-CM-1-3, MRP 5.46, "Safety Classification of Systems, Components, and Structures".

A preliminary safety equipment list is provided in Appendix D. This list may be revised, as required, based on issuance of the Preliminary Safety Evaluation and Safety Analysis reports. Safety Class 1 is the highest classification anticipated for any system, component and/or structure of the facility. For management review purposes, MWTF QA documents shall be assigned Impact Level I in accordance with MRP 5.4.3, "Impact Levels".

5.6.3 Interface Coordination

Project Management Plans, Statements of Work, and QAPP will designate the required interface between operating contractor, architect/engineer, contractors and subcontractors to achieve QA requirements without duplication of effort.

5.7 DECONTAMINATION AND DECOMMISSIONING

5.7.1 U.S. Department of Energy Regulations

The following DOE regulations are applicable to decontamination and decommissioning activities:

- Department of Energy Order 6430.1A, Section 1300-11, "Decontamination and Decommissioning."

- Department of Energy Order 5820.2A, Chapter V, "Decommissioning of Radioactivity Contaminated Facilities."

5.7.2 Miscellaneous Design Features

The facility design shall have the features specified in DOE Orders listed in Section 5.7.1, above, to facilitate future decontamination and decommissioning tasks. As a minimum, the following design features shall be provided and addressed:

- Tank configurations which minimize liquid heels and thus reduce dilution solutions and liquid waste generation.

- Washable paints or metal liners on concrete surfaces which have potential for contamination.

- Fully drainable piping systems that carry contaminated or potentially contaminated liquids.

- Location of exhaust filtration components of the ventilation system so as to minimize long runs of internally contaminated ductwork.

- Closure and postclosure plan will be developed during detailed design per WAC 173-303-610.

5.8 OPERATING PERSONNEL AND SERVICES

A staff of 40 to 60 operating personnel will be required to perform the maintenance and provide data collection services at the tank farm. Changerooms and support facilities shall be provided to accommodate 40 workers, including offices for radiation protection technicians, decontamination room, and laundry storage room. Facilities will be provided for both male and female workers (approximately 40% female).

5.9 COMMUNICATIONS AND TELECOMMUNICATION SYSTEMS

The MWTF shall be integrated into the existing site-wide communication and emergency annunciation system. All areas of the facility shall have adequate coverage to ensure that all personnel are notified in case of an emergency. The audio voice notification by speakers will be designed for adequate speech sentence intelligibility when calculated from the articulation index method per American National Standards Institute, ANSI S3.5.

Coverage of areas with high ambient noise levels shall be assured by the addition of a visual signaling device. The maximum sound pressure at the ear shall not exceed the levels set forth in CFR, 29 CFR 1910.95, "Occupational Noise Exposure."

Telephone communication shall be provided in all areas of the facility. Telephones shall be installed in the control room, in the sampling area, the offices, in the receiving area, and outside the main entrance to allow communication when the facility is locked up.

The alarm/communications system or equipment shall be Underwriters Laboratories listed and/or Factory Mutual approved.

5.10 AUTOMATIC DATA PROCESSING

The MWTF is not intended to process or store special nuclear material or generate classified information. As such, no special requirements are expected to be applied to the data processing system, if any, used by the facility. However, the facility shall be designed with equipment required by Hanford Site security and emergency response plan procedures for computerized data storage and transmittal.

6.0 GENERAL CRITERIA AND STANDARDS

U.S. CODE OF FEDERAL REGULATIONS

- 29 CFR 1910, Title 29, Part 1910, "Occupational Safety and Health Standards."
- 40 CFR 61, Subpart H, "National Emission Standards for Radionuclide Emissions from Department of Energy (DOE) Facilities."
- 40 CFR 260, "Hazardous Waste Management System General."
- 40 CFR 261, "Identification and Listing of Hazardous Waste."
- 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities."
- 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"

U. S. DEPARTMENT OF ENERGY-HEADQUARTERS

- "A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA), DOE/EV/1830.T5, U.S. Department of Energy." prepared by DOE.
- Department of Energy Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements."
- Department of Energy Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards."
- Department of Energy Order 5480.1B, "Environmental, Safety, and Health Program for Department of Energy Operations."

- Department of Energy Order 5480.5, "Safety of Nuclear Facilities."
- Department of Energy Order 5480.19, "Conduct of Operations."
- Department of Energy Order 5481.1B, "Safety Analysis and Review System."
- Department of Energy Order 5480.7, "Fire Protection."
- Department of Energy Order 5820.2A, "Radioactive Waste Management."
- Department of Energy Order 5480.11, "Radiation Protection for Occupational Workers."
- Department of Energy Order 6430.1A, "General Design Criteria."
- Department of Energy Order 5400.5, "Radiation Protection of the Public and the Environment."
- Department of Energy Order 5632.6, "Physical Protection of DOE Property and Unclassified Facilities."
- Department of Energy Order 5700.6C, "Quality Assurance."
- Department of Energy, DOE/EP-0108, "Standard for Fire Protection of DOE Electronic Computer/Data Processing System."

DEPARTMENT OF ENERGY RICHLAND FIELD OFFICE

- "Heating, Ventilating, and Air Conditioning," HPS, SDC-5.1, Revision 6.
- Department of Energy-Richland Operations Order RLIP 5480.11, "Requirements for Radiation Protection."

APPENDIX B

NOMINAL CHEMICAL COMPOSITION (Continued)

Nonvolatile Oxides*	Wt% of Total Nonvolatile Oxides
TiO_2	1.0 E-02
Tm_2O_3	1.7 E-10
Tm_2O_3	1.7 E-10
U_3O_8	4.7 E+00
Y_2O_3	2.0 E-01
ZrO2	1.5 E+01
Miscellaneous Feed Components	
Volatiles	**lb/100 lb of oxides**
NO_3	1.9 E+01
NO_2	2.4 E+00
Cl	3.0 E-01
OH	1.5 E+00
CO_3	1.7 E-01
TOC	2.0 E+00

NOTE: Nominal overall waste loading is 0.26 lb nonvolatile oxides/gal.

*Listing of "nonvolatile components" includes semi-volatiles.

*Nominal Chemical Compositions are based on HWVP, document WHC-SD-HWV-FDC-001, Rev 4, requirements.

APPENDIX C

Maximum Radionuclide Composition

9513322.0062

APPENDIX C

MAXIMUM RADIONUCLIDE COMPOSITION					
Isotope	Ci/gal	Isotope	Ci/gal	Isotope	Ci/gal
^{3}H	3.63 E-05	^{113}Sn	7.12 E-06	^{147}Pm	1.12 E+01
^{14}C	2.54 E-06	^{115m}Cd	2.48 E-09	^{148m}Pm	3.73 E-09
^{55}Fe	3.97 E-02	^{119m}Sn	1.53 E-03	^{151}Sm	2.36 E-01
^{59}Ni	3.84 E-05	^{121m}Sn	2.99 E-05	^{152}Eu	7.74 E-04
^{60}Co	1.21 E-03	^{123}Sn	8.17 E-04	^{153}Gd	3.26 E-06
^{63}Ni	4.44 E-03	^{126}Sn	1.30 E-04	^{154}Eu	9.48 E-02
^{79}Se	1.10 E-06	^{124}Sb	9.87 E-09	^{155}Eu	1.16 E-01
^{89}Sr	1.84 E-05	^{126}Sb	1.83 E-05	^{160}Tb	3.12 E-08
^{90}Sr	1.18 E+01	^{126m}Sb	1.30 E-04	^{234}U	1.36 E-06
^{90}Y	1.18 E+01	^{125}Sb	4.97 E-01	^{235}U	5.56 E-08
^{91}Y	2.05 E-04	^{125m}Te	1.21 E-01	^{236}U	1.34 E-07
^{93m}Nb	1.63 E-04	^{127}Te	8.34 E-04	^{238}U	1.05 E-06
^{93}Zr	3.65 E-04	^{127e}Te	8.47 E-04	^{237}Np	5.63 E-05
^{95}Zr	7.80 E-04	^{129}Te	1.06 E-10	^{238}Pu	2.17 E-04
^{95}Nb	1.60 E-03	^{129m}Te	1.63 E-10	^{239}Pu	3.97 E-04
^{99}Tc	2.64 E-03	^{129}I	4.60 E-09	^{240}Pu	1.53 E-04
^{103}Ru	8.42 E-08	^{134}Cs	3.40 E-01	^{241}Pu	7.28 E-03
^{103m}Ru	7.59 E-08	^{135}Cs	7.08 E-05	^{242}Pu	3.70 E-08
^{106}Ru	1.41 E+00	^{137}Cs	1.44 E+01	^{241}Am	1.63 E-01
^{106}Rh	1.41 E+00	^{137m}Ba	1.36 E+01	^{242}Am	1.17 E-04
^{107}Pd	1.15 E-05	^{141}Ce	3.19 E-09	^{243}Am	1.91 E-05
^{110m}Ag	4.50 E-04	^{144}Ce	8.42 E+00	^{242}Cm	1.41 E-04
^{113m}Cd	4.11 E-03	^{144}Pr	8.42 E+00	^{244}Cm	3.53 E-03
^{113m}In	7.12 E-06	^{144m}Pr	1.01 E-01		
Total activity (Ci/gal) 8.42 E+01 Decay heat (W/gal) 2.40 E-01					

NOTE: Radionuclide composition values given in this table are based on a "nominal" overall waste loading of 0.26-lb nonvolatile oxides/gal.

APPENDIX D

Multi-Function Waste Tank Facility Safety Classification Designations

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown FDC Identification	Safety Class
Waste Storage Primary Tank	· Primary Tank	1
Primary Tank Dome Penetrations	· Primary Tank Risers	2
	· Welded Attachments	2
Waste Storage Secondary Tank and Concrete	· Secondary Tank Liner	2
	· Secondary Tank Concrete	2
Secondary Tank Penetrations	· Secondary Tank Risers	2
	· Welded Attachments	2
Waste Storage Tank Refractory Concrete Pad	· Refractory	1
Process Piping (Inner pipe) - including jumpers	· Jumpers	2
	· Diversion Box 2 to Central Valve Pit Piping	2
	· Primary Process Piping	2
	· Tank Sample Piping	2
	· Glove Boxes	2
	· Encased Drain Piping (carrying process fluids)	2
Process Piping (outer pipe)	· Process Piping Encasements	2
	· Drain Piping Encasements	2

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown FDC Identification	Safety Class
Process Valve Pits (Diversion Boxes)	· Valve Pit	2
	· Diversion Boxes	2
	· Jumper Storage Pit	3
	· Sampling Pit	3
	· Mixing Pump Pit	3
	· Annulus Pump Pit	3
	· Leak Detection Pit	3
	· Cross Over Pit	3
	· Corrosion Sample Pit	3
	· Transfer Pump Pit	3
	· Drain Pit	3
	· Primary Exhaust Pit	3
	· Primary Air Inlet Pit	3
	· Pit Liners/ Protective Coatings	3
	· Leak Detection Well	3
	· Flush Pit	3
Sump Pumps	· Leak Detection Pit Pump Assembly	3
	· Annulus Pump Assembly	3

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY
SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown . FDC Identification	Safety Class
Primary Tank Ventilation - including Ducting	Air Intake System (HEPA, Heater, Piping)	2
	Air Intake Isolation Valve	2
	Piping from Tank to Ventilation Building	2
	Encasement	2
	Condensers	2
	HEME Housing (vessels)	2
	HEPA Housing	2
	Heaters	2
	Exhaust Fans	2
	Stack	2
	Seal Pot (Loop)	2
	Primary Condensate Piping	2
Secondary Tank Annulus Ventilation	Inlet Air System (HEPA Filters, Heaters, Air Distri-bution Piping)	3
	Annulus Exhaust System (Piping, Heaters, HEPA Filters)	3
	Annulus Exhaust Fans	3
	Annulus Piping Downstream of Fans	3
	Stack	3
	Annulus Air Exhaust Equipment Room	3

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown FDC Identification	Safety Class
Temperature Measurement	Temperature Measurement	2
Level Indicator Leak Detection Elements (LDE)	Liquid Leak Detection	2
	Corrosion Instrumentation	2
Level Indicator Level Elements (LE), Level Indicators (LI)	Liquid Level Measurement	3
	Sludge Monitoring	2
Ventilation System Differential Pressure Indicators (DPI)	HVAC Pressure Differential	2
Primary and Secondary Tank Pressure Indicators (PI)	Pressure Measurement/Monitoring/ Controls	2
Radiation Monitoring System	Air Radiation Monitoring/Alarms/ Interlocks	2
	Stack Exhaust Sampling and Monitoring/Alarms/ Interlocks	2
Control Systems (MCS/DCS)	Vacuum Control	2
	MCS/DCS Control Systems	2
Primary Tank Mixing System	Waste Mixing Assembly	3
Transfer Pumps	Transfer Pump Assembly	3
Waste Sampling System (excluding piping)	Waste Sampling Assembly	3

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown FDC Identification	Safety Class
Normal Power	Normal Power	3
Back-up Power	Back-up Power Source	2
	Diesel Generator/ Diesel Fuel System	2
Uninterruptible Power Supply (UPS)	UPS (Batteries/ Charger)	2
Fire Protection Systems	Fire Protection Sytems and Fire Alarms	2
Ventilation Buildings	Primary Ventilation Equipment Building	2
	Electrical Equipment Room	2
	Control Room	2
Generator Building	Diesel Generator Building	2
Air Compressors (1)	Instrument Air/ Compressors	2
Non-Process Piping (Drains, Drain Seals, non-encased lines, (etc.) (1)	Non-Encased Drain Piping (Non-Process Piping)	3
	Dummy Pump Heads	3
	Pit Drain Seal Assemblies	3
	Process Line Blanks	3
	Raw Water Spray Washdown	3
	Flush Lines	3
	Raw Water Line	3
	Leak Detection Pit Pump Discharge Lines	3
	Vent Lines	3

APPENDIX D

MULTI-FUNCTION WASTE STORAGE FACILITY SAFETY CLASSIFICATION DESIGNATIONS

Systems/Structures/ Components PSE Identification	Sub-component Level Breakdown FDC Identification	Safety Class
Non-Process Piping (Drains, Drain Seals, non-encased lines, etc.) (1)	Steam High Pressure Lines	3
	Steam Low Pressure Lines	3
	Pit Exhaust Sample Lines	3
Auxiliary Systems (1)	Raw Water System	3
	Chemical System	3
	Cooling Towers	3
	Heat Exchangers	3
Auxiliary Structures (1)	Weather Protection Enclosure	3
	Sample Building	3
	Service Building	3
	Change Room	3
Auxiliary Instrumentation (1)	Heat Trace	3
	Cathodic Protection	3
	Lighting	3
	Communications	3
	Signals	3
	Corrosion Retrieval Assemblies	3

NOTE: The identification of systems, structures and components given in Column 1 is the same as in PSE. The items marked (1) are not specifically identified in the PSE. However, the safety classification of these items is intended as shown.

*Reference bases Preliminary Safety Evaluation for the "Multi-Tank Waste Storage Facility," document WHC-SD-W236-PSE-001.

APPENDIX E

Waste Tank Dome Penetrations

APPENDIX E

WASTE TANK DOME PENETRATIONS

RISER NO.	QTY	SIZE	FUNCTION	ANGLE	RADIUS
1	3	6"	Spare	90°, 215°, 325°	17'-6"
2	1	6"	Liquid Level (LIT)	330°	10'-0"
3	1	24"	Transfer Pump	270°	6'-0"
4	2	12"	Observation Port	45°, 210°	10'-0"
5	1	6"	Spare	90°	22'-0"
6	2	24"	Annulus Access	90°, 270°	38'-6-3/8"
7	1	24"	Primary Exhaust	105°	28'-9"
8	8	6"	Air Inlet To Tank Refractory	15°, 60°, 105°, 150°, 195°, 240°, 285°, 330°	39'-3"
9	4	8"	Annulus Exhaust	62°-30', 140°-30', 242°-30', 332°-30'	38'-9"
10	2	12"	Spare	79°, 324°	30'-0"
11	1	42"	Spare (Retrieval Pump)	--	--
12	2	12"	Observation Port	225°, 317°	26'-0"
13	2	4"	Tank Pressure	238°, 307°	31'-6"
14	1	12"	Transfer Return	270°	9'-0"
15	1	6"	Spare	30°	16'-0"
16	6	6"	Spare	24°, 73°, 130°, 215°, 285°, 334°	30'-0"
17	16	12"	Annulus Inspection	18°, 36°, 54°, 78°, 108°, 126°, 144°, 162°, 191°, 216°, 236°, 256°, 278°, 300°, 324°, 349°	39'-3"
18	2	18"	Annulus Inspection	0°, 180°	39'-0"
19	6	6"	Annulus Instrumentation	49°, 117°, 165°, 228°, 295°, 342°	39'-4"
20	1	12"	Annulus Pump Out	206°-30'	38'-9"
21	1	12"	Contaminated Drain	183°	31'-0"
22	4	6"	Sludge Level	0°, 90°, 180°, 270°	14'-0"
23	3	6"	Level Detector Indicator	99°, 222°, 337°	38'-9"
24	1	6"	Spare	110°	32'-0"
25	1	6"	Liquid Level (High LE)	270°	20'-0"
26	1	6"	Liquid Level (LI)	137°	10'-0"
27	2	6"	Spare	155°, 315°	14'-0"
28	1	6"	Service and Flush Pit Drain or Spare	195°	34'-0"
29	1	12"	Sample - Process	141°	33'-0"

APPENDIX E

WASTE TANK DOME PENETRATIONS (Continued)

RISER NO.	QTY	SIZE	FUNCTION	ANGLE	RADIUS
30	6	42"	Mixing Pump	0°, 60°, 120°, 180°, 240°, 300°	21'-0"
31	1	16"	Primary Vent-Thru	280°	17'-0"
32	1	12"	Corrosion Sample	5°	33'-0"
33	1	12"	Corrosion Sample	355°	33'-0"
34	1	6"	Thermocouple	42°	29'-6"
35	1	6"	Thermocouple or Spare	250°	31'-6"
36	2	24"	Spare	90°, 270°	29'-6"
37	4	24"	Spare	26°, 154°, 206°, 334°	24'-0"
38	1	4"	Sample - Gas	90°	9'-0"
39	3	4"	Sample - Gas	65°, 163°, 293°	33'-0"
40	1	6"	Drain	172°	34'-0"
41	1	18"	Spare	205°	32'-0"
42	1	4"	Spare	228°	14'-0"
43	1	8"	Spare	19°	34'-0"
44	1	16"	Spare	341°	33'-0"
45	1	12"	Primary Air Inlet	30°	34'-0"
46	1	18"	Primary Vent-Recirc.	262°	28'-6"
47	1	4"	Sample Return-Process	103°	35'-0"
48	1	6"	Annulus Sump Instrumentation	112°	38'-9"
49	2	6"	Spare	70°, 250°	38'-9"
50	2	8"	Spare	113°, 319°	38'-9"

Note: **Waste Tank Dome Penetration are based on past operation requirements and the new proposed operational/monitoring needs.**

- "Standard Specification for Compressor-Supplied Breathing Air Systems," HPS-156-M, Revision 2, "Hanford Plant Standards."
- "Standard Specification for Fire- and Moisture-Resistant Nuclear Grade HEPA Filters," HPS-157-M, Revision 1, "Hanford Plant Standards."
- "Standard Specification for Hydrogen Fluoride- and Caustic-Resistant Nuclear Grade HEPA Filters," HPS-158-M, Revision 1, "Hanford Plant Standards."
- "Standard Specification for Fire-, Moisture-, and Chemical-Resistant Nuclear Grade HEPA Filters," HPS-159-M, Revision 1, "Hanford Plant Standards."
- "Standard Specification for Fire- and Moisture-Resistant, High Temperature and High Humidity Nuclear Grade HEPA Filters," HPS-160-M, Revision 1, "Hanford Plant Standards."
- "Standard Specification for Self-Contained Fire- and Moisture- Resistant Nuclear Grade HEPA Filters," HPS-161-M, Revision 0, "Hanford Plant Standards."
- "Standard Specification for Self-Contained Fire-, Moisture-, and Chemical-Resistant Nuclear Grade HEPA Filters," HPS-162-M, Revision 0, "Hanford Plant Standards."
- "Standard Specification for Fire Specification for Self-Contained High Temperature and High Humidity Nuclear Grade HEPA Filters," HPS-163-M, Revision 0, "Hanford Plant Standards."
- Department of Energy-Richland Operations Order RLIP 5300.1B, "Telecommunications."

- "Design Load for Structures," SDC-4.1, Revision 11, "Hanford Plant Standards."

- Department of Energy-Richland Operations Order RL 4320.2C, "Site Selection."

- Department of Energy-Richland Operations Order RL 6430.1C, "Hanford Plant Standards/Program."

WESTINGHOUSE HANFORD COMPANY

- "In-Place Efficiency Testing of Gaseous Effluent HEPA Filter System," Hanford Works Standard (HWS), HWS-10278.

- "Hazardous Materials Packaging and Shipping," document No. WHC-CM-2-14.

- "Industrial Safety Manual," document No. WHC-CM-4-3, Volumes 1, 2, and 3.

- "Radiological Design," document No. WHC-CM-4-9.

- "Radiation Protection," document No. WHC-CM-4-10.

- "ALARA Program Manual," document No. WHC-CM-4-11.

- "Nuclear Criticality Safety," document No. WHC-CM-4-29.

- "Security Manual," document No. WHC-CM-4-33.

- "Nonreactor Facility Safety Analysis Manual," document No. WHC-CM-4-46.

- "Standard Engineering Practices," document No. WHC-CM-6-1.

- "Management Requirements and Procedures Manual," document No. WHC-CM-1-3.

- "Environmental Compliance," document No. WHC-CM-7-5.

- "Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements," document No. WHC-EP-0063.

- "Jumper Fabrication," document No. HS-BS-0084.

- "Backup Electric Power System Definitions and Design Criteria," document No. WHC-SD-GN-DGS-303.

- Site Evaluation Report, "Multi-Waste Tank Storage Facility," document No. WHC-SD-W236-SE-001.

- "Double Shell Waste Tank In-tank Corrosion Monitoring Program," document No. WHC-SD-WM-EV-054.

INDUSTRY STANDARDS AND CODES

- "Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants," ANSI N300-1975 (R1981), 1975.

- "Design, Construction, and Operation of Ventilation Systems for Mixed Oxide UO_2 - PuO_2) Fuel Fabrication Plants," ANSI N290, 1979.

- "National Electrical Safety Code," ANSI C2 Handbook, 1990.

- "Storage/Retrieval (S/R) Machines and Associated Equipment," ANSI/ASME B30.13, 1985.

- ASNI B31.3, "Chemical Plant and Petroleum Refinary Piping."

- "Hooks," ANSI/ASME B30.10, 1987.
- "Guide to Sampling Airborne Radioactive Material in Nuclear Facilities", ANS7 N13.1, 1969
- "Specifications and Performance of On-Site Instrumentation for Continuously Monitoring Radioactive Effluents," ANSI N4 2.18-74, 1980.
- "Nuclear Power Plant Air Cleaning Units and Components," ASME N509, 1989.
- "Boiler and Pressure Vessel Code," Section III, Nuclear Power Plant Components, Division 1, 1989.
- "Software Quality Assurance Plans," ANSI/IEEE 730-1984.
- "Boiler and Pressure Vessel Code," Section VIII, "Pressure Vessels," Division 2, ASME, 1989.
- "Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter," American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 52-1976.
- Institute of Electrical and Electronic Engineers, "Application of the Single-Failure Criteria by Nuclear Power Generating Station Safety Systems (ANSI)," IEEE Standard 379.
- Institute of Electrical and Electronic Engineers, "Criteria for Independence of Class IE Equipment and Circuits (ANSI)," IEEE Standard 384.
- American Society of Heating, Refrigeration, and Air-Conditioning Engineers, "ASHRAE Handbook/1989 Fundamentals."

- "National Electrical Code," NFPA 70-1990 (latest issue).

- "National Fire Codes," NFPA, 1990 (latest issue).

- Munson, L. H., "Health Physics Manual of Good Practices for Reducing Radiation Exposure to Levels that are As Low As Reasonably Achievable (ALARA)," Pacific Northwest Laboratory 6577, 1988.

- MIL-STD-1472D, Section 5.7.5, Standard Console Design.

- United States Environmental Protection Agency Document PB87-13439, "Technical Resource Document for the Storage and Treatment of Hazardous Waste in Tank Systems."

STATE REGULATIONS

- "Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides," Chapter 402-80, Washington Administrative Code, 1989.

- "Public Water Supplies," Chapter 248-54, Washington Administrative Code, 1989.

- "Dangerous Waste Regulations," Chapter 173-303, Washington Administrative Code, 1991.

In addition to the above standards, applicable Hanford standards, Occupational Safety and Health Administration standards, the national consensus codes, and standards developed by such organizations as the ASME, American Society of Testing Materials, ANSI, American Concrete Institute, Instrument Society of America, American Water Works Association, and IEEE shall be used as determined by subsequent design phases.

TABLE 1

PRIMARY TANK DESIGN CRITERIA

Design Criteria	Criteria Value	Basis
Capacity	1,160,000 gal	• Maximum tank size utilized at Hanford. • Present 75 ft diameter tanks have a proven self-supporting dome design. • Reference: Letter, Blume to B. E. Whittlesey (Vitro), Results of 241-AW Primary Steel Tank Additional Analyses, Consultant Agreement C-2.32, Mod. 22", August 28, 1981. • Assumes filling tanks of the existing 241-AW configuration to a point just below the upper wall knuckle.
Specific Gravity	2.0	• Functional Design Criteria, SD-535-FDC-001, 241-AQ Tank Farm Project B-535.
pH	5 to 14	• Functional Design Criteria, SD-535-FDC-001, 241-AQ Tank Farm Project B-535. • Functional Design Criteria, WHC-SD-W058-FDC-001, Cross Site Transfer Line.
Temperature Limit for Stress	250°F maximum in primary tank steel 250°F maximum at lower knuckle of the primary tank steel 200°F maximum in haunch and dome steel	• The tank will be designed to operate within the parameters shown. • The design will analyze and establish maximum temperature cycling criteria based on primary tank steel temperature fluctuations between ambient and 200°F in conjunction with the liquid level cycling criteria. • Analysis of Tank Bump Potential During In-Tank Washing Operations Proposed for the 241-AZ Tanks, (WHC-SD-WM-ER-114).
Heat Generation	2,600,000 Btu/hr	• Analysis of Tank Bump Potential During In-Tank Washing Operations Proposed for the 241-AZ Tanks, (WHC-SD-WM-ER-114).
Stress	Refer to ASME Section III	• The primary tank steel shall be designed not to exceed allowable stresses.
Bottom Slope and Flatness	Maximum height = 3 in. Minimum slope = 3% Maximum curvature crown = 480 in. Radius root = 357-in. radius	• Based on Battelle document SAM-76-1

TABLE 1

PRIMARY TANK DESIGN CRITERIA (Continued)

Design Criteria	Criteria Value	Basis
Corrosion	.4 mil/yr	• Based on 50 yr tank life, general corrosion would be less than 10% of the original thickness which is within design allowances. • Basis is conservative because waste will cool with age and decay. Laboratory data indicated corrosion less than 0.1 mil/yr at 25°C. • Stress corrosion cracking has not yet been demonstrated on test samples with these solutions. • A corrosion study is planned to be performed prior to detail design to verify stress corrosion cracking.
Pressure	Maximum: (Reference Table 2) Minimum: -12 in. water	• Operating pressure: -6 in. water
Seismic	As defined in SDC-4.1 for design basis earthquake	• Earthquake loads for Safety Class 1 facilities require design for the design basis earthquake to ensure a safe and orderly shutdown of the facility.
Tank Level Cycling	Maximum fill and drain rate = 160 gpm Fluid temperature: 200°F Viscosity = 10.0 cp Solids, by volume = 30% Four filling cycles per year	• Cycle defined as filling an empty tank at ambient temperature with 1,100,000 gal of waste and draining until empty. • Proposed operational use.
Material	Stainless Steel	• WHC DST Retrieval Sludge Washing requirements. • INEL, Test Results HLWTFR Project Corrosion Studies. • PNL, Materials Selection for Remote Process Components, Study.
Maximum Radionuclide Composition	See Appendix C	• HWVP FDC

TABLE 2

DESIGN CRITERIA FOR REINFORCED CONCRETE STRUCTURE WITH SECONDARY LINER

Design Element	Criteria Value	Basis
Pressure	+60 in. water -12 in. water	• Functional Design Criteria, SD-535-FDC-001, 241-AQ Tank Farm, Project B-535.
Temperature	200°F maximum in haunch and dome 250°F maximum in wall and footing	• Maximum temperature in the concrete shall be low enough to ensure structural integrity throughout the design life of the tank.
Heat Generation	Same as primary tank	• See table 1 for heat generation design element.
Seismic	Same as primary tank	• Seismic analysis assumes worst case liquid level in annulus.
Dead Load	Earth cover will be compacted to maximum density. Depth to be determined by shielding and analysis.	• Minimum earth cover based on radiation shielding requirements over the tank and facilities on top of the tank. • Design basis earthquake analysis will determine earth cover based on the results of a radiation shielding analysis.
Live Load	A maximum of 40 lb/ft^2 uniform plus 50 ton concentrated at any point.	• Live loading on the tank was based on previous tank criteria which allows for a crane plus the heaviest movable equipment having a total gross weight of 150 tons (refer to Letter, 4/80, F. R. Vollert to T. J. Ehli).
Material	2 HWVP dedicated tanks: Stainless Steel Other 2 tanks: Carbon Steel	• See Table 1, Material Basis.
Stress	ASME, Section VIII, Division 2	• Department of Energy, Order 6430.1A, "General Design Criteria".

TABLE 3

PIPING DESIGN CRITERIA

Design Element	Criteria Value	Basis
WASTE		
Size	3 in. and 2 in.	• Based upon worst condition.
Temperature	Operating - 200°F	• Based upon evaporator temperatures. • Based on Project W-058 FDC criteria.
Pressure	400 psig	• Based on the maximum transfer pump discharge pressure.
Slope	0.25%/ft minimum	• Minimum slope to flat shall include jumper routings through any required process pits. • Negative slope shall not be allowed.
Encasement Piping	6 in. and 4 in.	
Temperature	Same as Primary.	
Pressure	Same as Primary.	
Slope	Same as Primary.	
Cathodic Protection	In accordance with recommended practices of NACE	

APPENDIX A

Chemical Compositional Range

APPENDIX A

CHEMICAL COMPOSITIONAL RANGE		
Chemical Composition Range Limits (Oxide Basis)	Wt% of Total Nonvolatile Oxides	
	Minimum	Maximum
Al_2O_3	2.0	26.0
BaO	0.0	20.0
CaO	0.0	20.0
CdO	0.0	10.0
Fe_2O_3	8.0	60.0
$(La,Nd)_2O_3$	0.0	8.0
MnO_2	0.0	20.0
MoO_3	0.0	8.0
Na_2O	4.5	22.0
NiO	0.0	8.0
SiO_2	0.0	17.5
TiO_2	0.0	4.0
U_3O_8	0.0	32.0
ZrO_2	0.0	40.0
Cr_2O_3	0.0	2.0
Noble metals (PdO, Rh_2O_3, Ru_2O_3)	0.0	1.0
P_2O_5	0.0	4.0
SO_3	0.0	2.0
F	0.0	6.9
Fission product elements and minor components	0.0	5.0*
Volatile components	lb/100 lb of Total Waste Oxides	
Cl	0.0	0.3
CO_3	2.4	30.0
NO_x (as NO_3)	0.0	36.0
TOC	0.0	11.0

APPENDIX A

CHEMICAL COMPOSITIONAL RANGE		
Chemical Composition Range Limits (Oxide Basis)	Wt% of Total Nonvolatile Oxides	
	Minimum	Maximum
Overall Waste Loading Limits		
lb total nonvolatile oxides/gal	0.21	0.83

* Maximum value for the sum of fission product elements and other minor components is 5.0 wt%.

TOC = Total organic carbon

- Chemical Composition Range is based on HWVP FDC, document WHC-SD-HWV-FDC-001, Rev. 4, requirements.

APPENDIX B

Nominal Chemical Composition

APPENDIX B

NOMINAL CHEMICAL COMPOSITION

Nonvolatile Oxides*	Wt% of Total Nonvolatile Oxides
Ag_2O	1.0 E-02
As_2O_3	4.3 E-05
Al_2O_3	9.0 E+00
Am_2O_3	2.0 E-02
B_2O_3	1.0 E-01
BaO	4.0 E-01
BeO	1.0 E-01
CaO	3.0 E-01
CdO	3.0 E-01
CeO_2	6.0 E-01
Cr_2O_3	5.0 E-01
Cs_2O	6.0 E-01
CuO	6.0 E-01
Dy_2O_3	1.0 E-04
Er_2O_3	3.1 E-06
Eu_2O_3	2.0 E-02
F	1.2 E+00
Fe_2O_3	2.8 E+01
Gd_2O_3	1.0 E-02
GeO_2	1.6 E-04
Ho_2O_3	5.3 E-06
I	4.5 E-06
In_2O_3	1.3 E-03
K_2O	05.0 E-02
La_2O_3	2.9 E+00
MgO	2.0 E-01
MnO_2	6.0 E-01
MoO_3	1.2 E+00

APPENDIX B

NOMINAL CHEMICAL COMPOSITION (Continued)

Nonvolatile Oxides*	Wt% of Total Nonvolatile Oxides
Na_2O	1.8 E+01
Nb_2O_3	1.0 E-02
Nd_2O_3	1.6 E+00
NiO	2.3 E+00
NpO_2	1.0 E-01
P_2O_5	8.7 E-01
PbO_2	5.0 E-02
PdO	2.0 E-01
Pm_2O_3	1.0 E-01
Pr_2O_3	4.0 E-01
PuO_2	2.0 E-02
Rb_2O_3	2.0 E-01
Rh_2O_3	2.0 E-01
Ru_2O_3	6.0 E-01
SO_3	6.5 E-01
Sb_2O_3	5.9 E-03
SeO_2	3.0 E-02
SiO_2	4.0 E+00
Sm_2O_3	2.0 E-01
SnO	4.0 E-02
SrO	4.0 E-01
Ta_2O_5	3.0 E-02
Tb_2O_3	2.3 E-04
Tc_2O_7	4.0 E-01
TeO_2	1.0 E-01

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